Method for fastening soft porous tubes.

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Abstract of **EP0338774**

Soft porous polymer tubes 1 are fastened into a fastening seat 2 by remoulding the tube ends by compression to remove porosity before insertion into the seat or by pressure insertion of a hard, strong tube 3 into each porous tube end, after insertion into the fastening seat, to compress it. An adhesive 6 is used to fill the seat to hold the tubes in place.

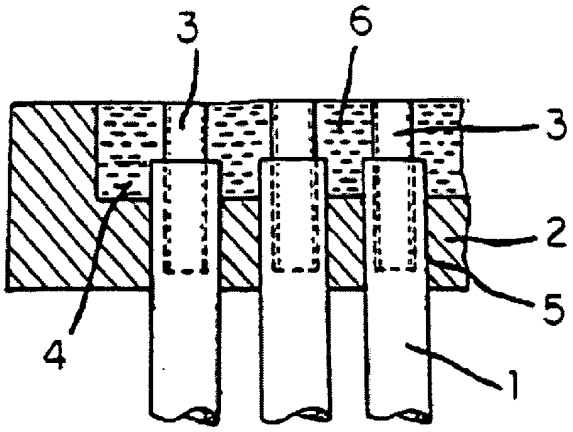

FIG. 1

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(54) Method for fastening soft porous tubes.

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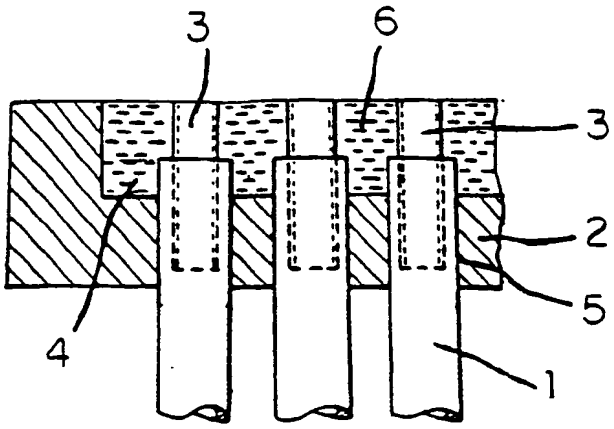

FIG. 1

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METHOD FOR FASTENING SOFT POROUS TUBES

The present invention relates to a method for fastening soft porous tubes to a fastening seat, in particular, for purposes of filtration, degassing or addition of active ingredients. By "porous" is meant gas permeable but not liquid permeable.

When a synthetic resin material, such as a paste moulding of a tetrafluoroethylene resin is subjected to a rolling or drawing treatment, a structure which is permeable to gases but impermeable to liquids can be obtained. By using a part, such as a tube, made from such a material, it is possible to remove gas components from liquids (degassing) or to add gases to liquids (gas diffusion). Of course, various types of filtration can be smoothly accomplished using such a tube.

However, in the case of parts, such as tubes, the synthetic resin may have a porosity of 70% or greater (80% or greater in some cases), and accordingly such parts are extremely soft. When such soft parts are fastened to degassing or gas diffusion mechanisms of the type described above, it is necessary to fasten the end portions of said parts to said mechanisms. This fastening is accomplished by screw-tightening using tube connectors and the like.

In order to perform an efficient degassing or gas diffusion treatment using the above tubes, it is desirable that the tubes themselves have a small diameter. However, in cases where such small-diameter tubes are fastened using the aforementioned tube connectors, said connectors have a relatively large external diameter, i.e. a diameter that is approximately five times the external diameter of the tubes. Furthermore, in order to fasten the tubes, it is necessary to apply a tool such as a spanner or monkey wrench to the connectors and to manipulate the tool.

Accordingly, a space sufficient for the manipulation of such a tool must be left between adjacent connectors. As a result, the space required for the fastening of a single tube is unavoidably large. For example, in a case where tubes with an internal diameter of 2 mm. and an external diameter of 3 mm. are fastened, the maximum number of tubes that can be fastened to a flat fastening seat with a diameter of 140 mm. is twenty-five.

Furthermore, in cases where such tubes are fastened by bonding with an adhesive, the setting of the adhesive causes a shrinkage of the tube diameter, so that an appropriate bonding strength cannot be obtained. As a result, gaps may be created such that leakage occurs.

Accordingly, although connectors may be used in order to ensure stable fastening, the need for space limits the number of tubes that can be installed per unit area to a small number. As a result, the benefits of efficient treatment and a compact apparatus cannot be achieved.

The present invention comprises a method for fastening soft porous polymer tubes to a fastening seat comprising the steps of:

(a) hardening an end of each said tube by filling the pores of said end of each said tube;

(b) inserting said filled and hardened tube ends into holes formed in said fastening seat so as to project beyond said fastening seat, and

(c) fastening said tubes in place in said seat by filling the space between the projecting tube ends with an adhesive.

Preferably the method includes hardening an end of each said tube by insertion into it by pressure fitting of a hard and high-strength tube to fill the pores of said tube by compression of the soft material of said tube after said tube has been inserted in said fastening seat. The ends of the soft porous tubes in which the ends are filled and hardened may be remoulded if needed.

Since the ends of the soft porous tubes are hardened by filling the pores in said ends, the insertion of said tube ends into the holes formed in the fastening seat is facilitated. Furthermore, since these filled and hardened portions of the tubes are caused to project from the fastening seat and are fastened in place by means of an adhesive, there is no deformation or change in the dimensions of the tubes, i.e. no shrinking of the tubes in the fastening area, and secure fastening can thus be achieved.

The filling of the pores in the fastening ends of the tubes can easily be accomplished without any need for special fastening parts by closing the porous structure of said tube ends by melting. At the same time, an appropriate degree of hardness can also be obtained by the filling of the pores by melting.

Some embodiments of the invention will now be particularly described, by way of example, with reference to the accompanying drawings, in which:-

Figure 1 is a partial magnified cross-section of an embodiment of the invention utilizing inserted hard tubes or pipes, and

Figure 2 shows another embodiment of the invention.

Figure 1 shows the application of the method of the invention to the fastening of soft tubes 1 to a fastening seat 2, the tubes having been made porous by a drawing treatment so that they are permeable only to gases. An adhesive fastening

area 4 is formed in the top surface of the fastening seat 2, which contains holes 5 into which the tubes 1 are inserted. Next, thin-walled pipes 3, which are as tough as possible and which also have a high hardness, such as for example stainless steel pipes, are inserted into the ends of tubes 1 and the Pores in the fastening ends of tubes 1 are filled by compression. The portions of the tubes that are hardened by this pore-filling treatment are inserted into holes 5 and an adhesive fastening layer 6 is formed around the portions of the tubes that project into the adhesive fastening area 4, so that the ends of tubes 1 are fastened by adhesion. Further, in cases where the pipes 3 are inserted into the fastening ends of tubes 1, it is not absolutely necessary to subject said fastening ends of tubes 1 to a separate compressive pore-filling treatment. However, such a pore-filling treatment may be appropriately performed as an auxiliary treatment.

Figure 2 illustrates another working embodiment of the present invention. In this embodiment, filled and hardened portions 1a are formed on the ends of tubes 1 that are to be inserted into fastening seat 2 and an adhesive fastening layer 6 is formed around the portions of the tubes that project into adhesive fastening area 4 in the same manner as in the embodiment illustrated in Figure 1. As a result, the filled and hardened portions 1a which constitute the end portions of tubes 1 are fastened in place by adhesion in the same manner as described above.

As to the method used to form the filled and hardened portions, the porous structure of the end portions of tubes 1 can be filled and hardened by subjecting said end portions to a partial melting treatment or to a compressive bonding treatment.

The use of either of the above methods (i.e., the method illustrated in Figure ,1 or the method illustrated in Figure 2) eliminates the need for a space for the installation of a connector around the circumference of each tube 1. Furthermore, the need for a space for manipulation of a tightening tool such as a spanner or monkey wrench, for example, which would have to be used in order to tighten such a connector, is also eliminated. Accordingly, the spacing of tubes 1 fastened to fastening seat 2 can be substantially narrowed. It was confirmed by experimentation that approximately 220 porous polytetrafluoroethylene tubes 1 with an internal diameter of 2 mm. and an external diameter of 3 mm. can be fastened to a fastening seat 2 having a diameter of 140 mm. This is close to 10 times the number of tubes that can be installed using the conventional method.

It is clear that if it is thus possible to increase the number of tubes 1 that can be installed in a unit space, it is possible to perform an efficient treatment by means of a compact apparatus. Thus, such a treatment can be performed using an economical apparatus which requires little space.

Claims

1. A method for fastening soft porous polymer tubes to a fastening seat comprising the steps of:

(a) hardening an end of each said tube by filling the pores of said end of each said tube;

(b) inserting said filled and hardened tube ends into holes formed in said fastening seat so as to project beyond said fastening seat, and

(c) fastening said tubes in place in said seat by filling the space between the projecting tube ends with an adhesive.

2. A method according to claim 1 including hardening an end of each said tube by insertion into it by pressure fitting of a hard and high-strength tube to fill the pores of said tube by compression of the soft material of said tube after said tube has been inserted in said fastening seat.

3. A method according to claim 1 including filling the pores of each said tube end by remoulding each said tube by compressing the porous material of said tube end prior to insertion in said fastening seat.

4. An assembly of soft porous polymer tubes fastened in place to a fastening seat by a method according to claim 1, claim 2 or claim 3.

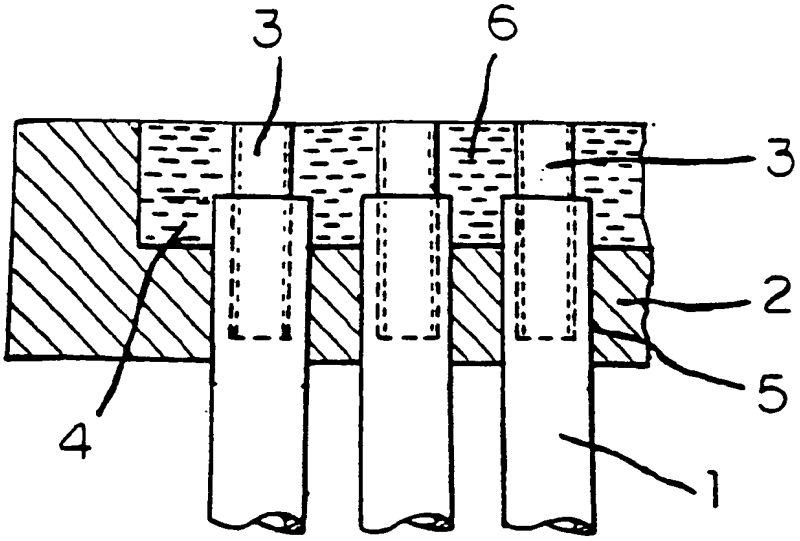

FIG. 1

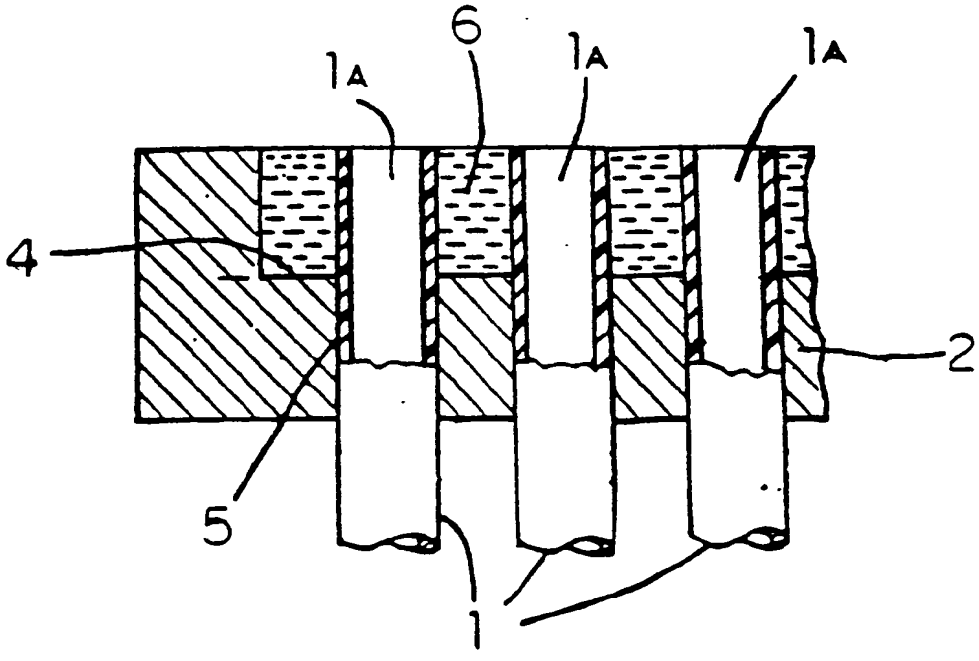

FIG. 2

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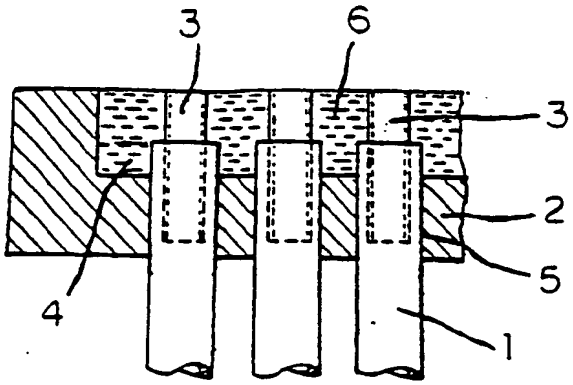

FIG. 1

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EUROPEAN SEARCH REPORT

Application Number

EP 89 30 3826

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
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Y	FR-A-2 399 637 (AIR-FROHLICH) * Fig.; claims *	1,3,4	
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	16-07-1990	CORDENIER J.

CATEGORY OF CITED DOCUMENTS

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DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
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A	PATENT ABSTRACTS OF JAPAN, vol. 9, no. 60 (M-364)[1783], 16th March 1985; & JP-A-59 195 095 (MITSUBISHI DENKI K.K.) 06-11-1984 -----		

TECHNICAL FIELDS SEARCHED (Int. Cl.4)

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	16-07-1990	CORDENIER J.

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